# **Station 1:** Homologous Structures and Evolution

Big Questions:

- Why are homologous structures used as evidence of evolution?
- How can vestigial structures be explained by natural selection?

Directions

1.) Pick a team leader

2.) Pass out a homologous structure worksheet and write your name. Answer 1-2.

3.) Get coloured pencils and draw in the homologous bones the same colour. Use the colour bone key.

4.) Answer 3-5.

5.) Take notes on analogous, homologous, and vestigial structures.

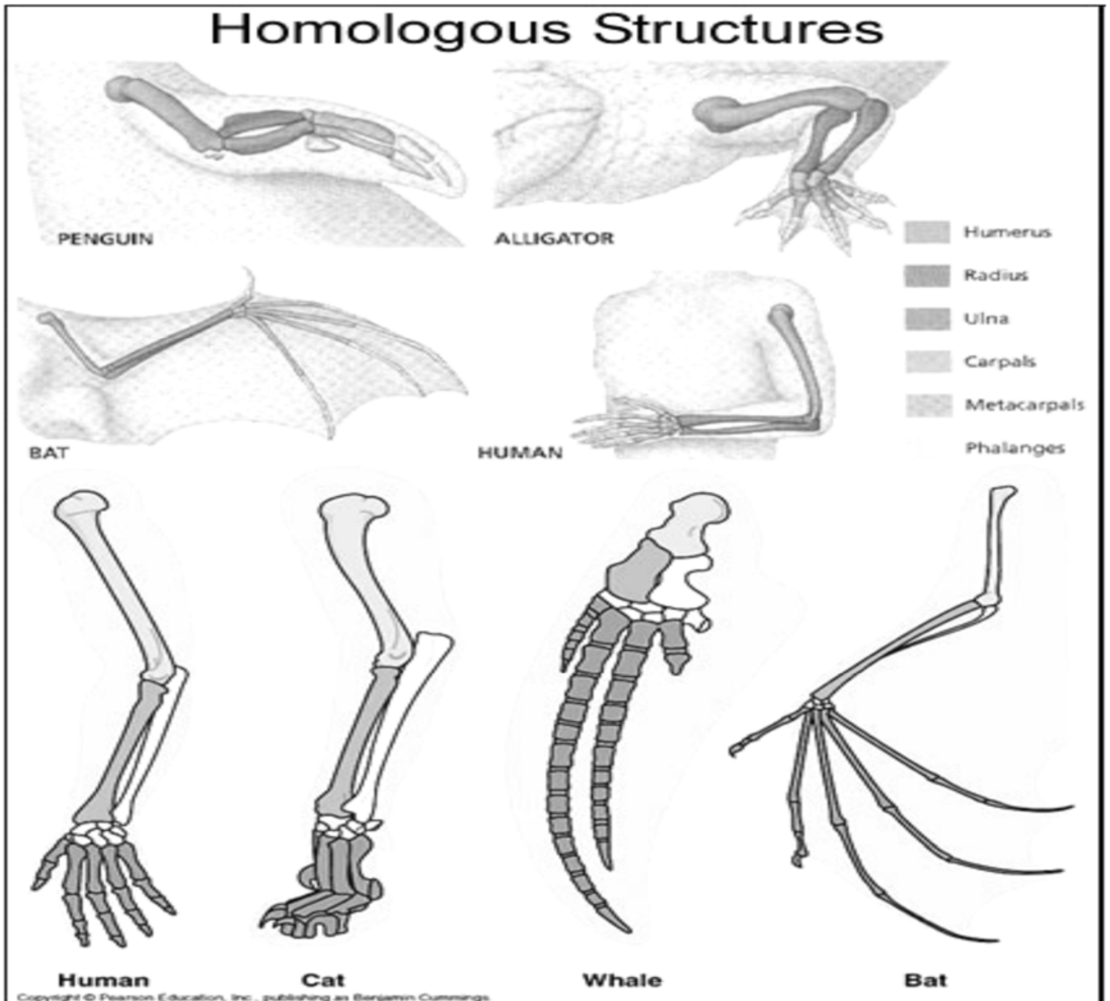
6.) Answer 2 proficiency questions.

7.) Call teacher when everyone has mastered the content at this station and you are all ready to answer the big question.

# Homologous Structures and Evolution

1.) Define. Homo = _______________

2.) Look below and then answer: what do you think homologous structures are?____________




*Use the following key and colours below to colour the homologous bones*
**Red** = *humerus bone* **Blue** = *radius bone* **Green** = *ulna bone* **Yellow** = *phalanges bones*
**Purple** = *carpals & metacarpals bones*

3.) Do homologous structures have the same function in different organisms?

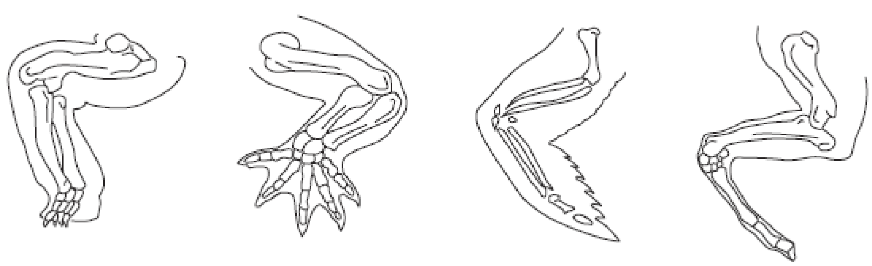
4.) What do homologous structures have in common?

5.) How does the existence of homologous structures support the theory of evolution?

## Analogous, Homologous and Vestigial Reading

Notes

PROFICIENCY QUESTIONS




1. The bones in the diagram above are examples of
   a. homologous structures. c. adaptation.
   b. fitness. d. struggle for existence.

2. A human's appendix and a skink's legs are examples of
   a. vestigial organs. c. natural selection.
   b. fitness. d. artificial selection.

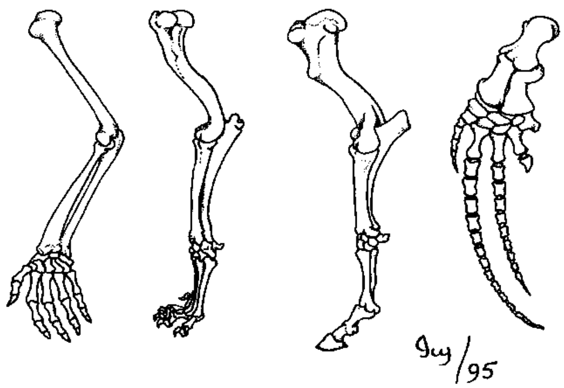
1.) I choose________ because_________________________________________

2.) I chose________ because_________________________________________

## Analogous Structures

When organisms living in similar environments independently evolve physically similar structures it is a process called <u>*convergent evolution*</u>. These structures or body parts are termed *analogous structures*. Some examples of analogous structures are:

- wings of birds and insects
- the streamlined bodies of seals and penguins



They may be different in their internal anatomy, because they are not a result of common ancestors.

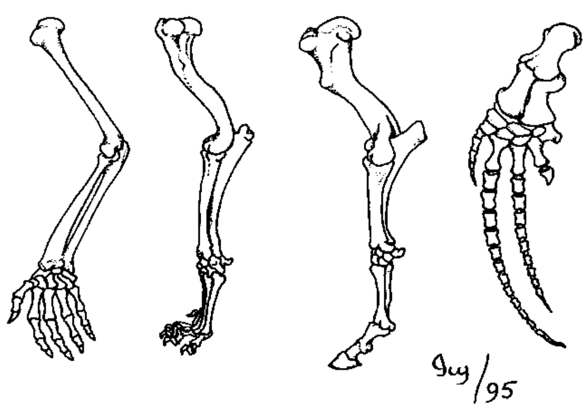
## Homologous Structures

**HOMOLOGOUS STRUCTURE** - structure that may differ in function but that have similar anatomy, presumably because the organisms that possess them have descended from common ancestors. This suggests that all animals started out from common ancestors and, through natural selection, were modified to perform different functions.

Some examples of homologous structures are:

- Bat, bird, and pterodactyl wings
- Seal and dolphin flippers
- Sheep and dog leg bones
- Shrew and human arm bones

Even though they serve many different purposes, the limbs of all these organisms contain many of the same sets of bones. These have been passed downed to all the different animals from a common ancestor.



## Vestigial Structures

Many organisms possess **vestigial structures** that have no apparent function, but that resemble structures their presumed ancestors had.

Natural selection explains why some animals have leftover body structures that aren't still needed. These structures are called vestigial structures. Some of these are:

- Molars in vampire bats
- Leg bones in snakes and whales
- Appendix and tailbone in humans

They may be different in their internal anatomy, because they are not a result of common ancestors.

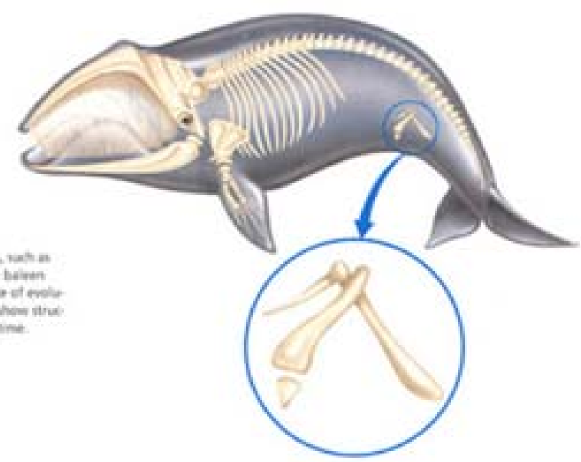


**Figure 15.8**
Vestigial structures, such as pelvic bones in the baleen whale, are evidence of evolution because they show structural change over time.

## **Station 2:** DNA and Evolution

| Big Question: How is DNA used to determine common ancestry? |
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| |

Directions

1.) Pick a team leader

2.) Pick up a DNA data sheet and compare the amino acids in the Hemoglobin molecule of eight species. Circle the differences in amino acids that each species has compared with humans.

3.) Fill in differences in the chart and give explanations.

4.) Call teacher when everyone has mastered the content at this station and you are all ready to answer the big question.

## Amino Acid Comparison: DATA SHEET

Compare each species' amino acid sequence with humans. Circle the differences in amino acids that each species has compared with humans.

| AMINO ACID | Species I **Human** | Species 2 **Common Gibbon** | Species 3 **Rhesus Monkey** | Species 4 **Chimp** | Species 5 **Gorilla** | Species 6 **Squirrel Monkey** | Species 7 **Ring-tail lemur** | Species 8 **Horse** |
|---|---|---|---|---|---|---|---|---|
| 1 | V | V | V | V | V | V | T | V |
| 2 | H | H | H | H | H | H | F | Q |
| 4 | T | T | T | T | T | T | T | S |
| 5 | P | P | P | P | P | G | P | G |
| 6 | E | E | E | E | E | D | E | E |
| 8 | K | K | K | K | K | K | N | K |
| 9 | S | S | N | S | S | A | G | A |
| 10 | A | A | A | A | A | A | H | A |
| 12 | T | T | T | T | T | T | T | L |
| 13 | A | A | T | A | A | A | S | A |
| 16 | G | G | G | G | G | G | G | D |
| 20 | V | V | V | V | V | V | V | E |
| 21 | D | D | D | D | D | E | E | E |
| 22 | E | E | E | E | E | D | K | E |
| 33 | V | V | L | V | V | V | V | V |
| 43 | E | E | E | E | E | E | E | D |
| 50 | T | T | S | T | T | T | S | N |

KEY TO THE ABBREVIATIONS FOR THE AMINO ACIDS IN BETA HEMOGLOBIN:

A: alanine G: glycine P: proline V: valine C: cysteine H: histidine Q: glutamine

Y: tyrosine D: aspartic acid K: lysine R: arginine E: glutamic acid L: leucine S: serine

F: phenylalanine N: asparagine T: threonine

**Record how many differences you saw in the amino acid comparison data sheet to humans**

| **Species** | **1** Human | **2** Common Gibbon | **3** Rhesus Monkey | **4** Chimp | **5** Gorilla | **6** Squirrel Monkey | **7** Ring-tail lemur | **8** Horse |
|---|---|---|---|---|---|---|---|---|
| Human | | | | | | | | |

| **Predict the order of closeness in which organisms are related to humans:** | |
|---|---|
| Most related | 1. |
| | 2. |
| | 3. |
| | 4. |
| | 5. |
| | 6. |
| Least related | 7. |

## **Station 3:** Embryos and Evolution

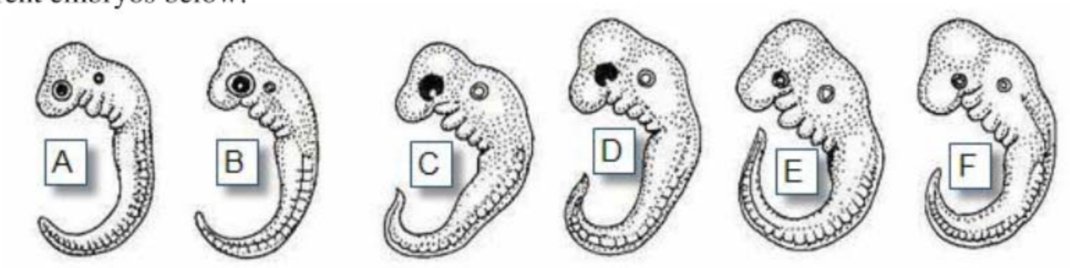
Big Question: How is the comparison of embryos used to determine relationship between species?

Directions

1. Pick a team leader
2. Pass out embryo paper and on each set of embryos, guess the species.
3. Call teacher to see correct embryo.
4. Answer questions 1-3.
5. Answer 2 payday questions.
6. Call teacher when everyone has mastered the content at this station and you are all ready to answer the big question.

# Embryology

Organisms that are closely related may also have physical similarities before they are even born! Take a look at the six different embryos below:

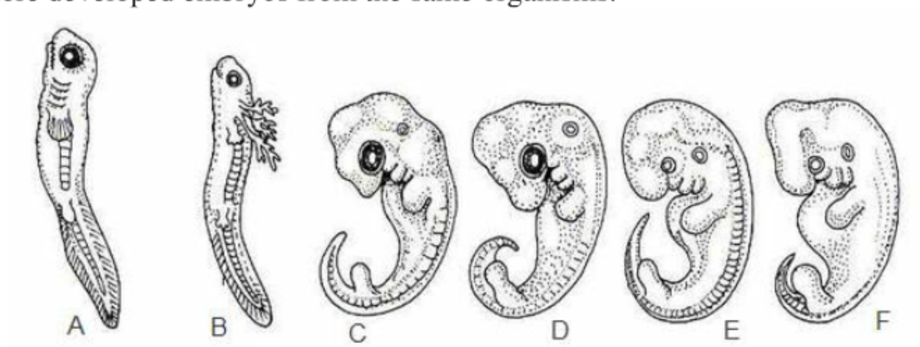



*Source: http://www.starlarvae.org*

Hypothesize which embryo is from each of the following organisms:

| Species | Embryo |
|---|---|
| Human | |
| Chicken | |
| Rabbit | |
| Tortoise | |
| Salamander | |
| Fish | |

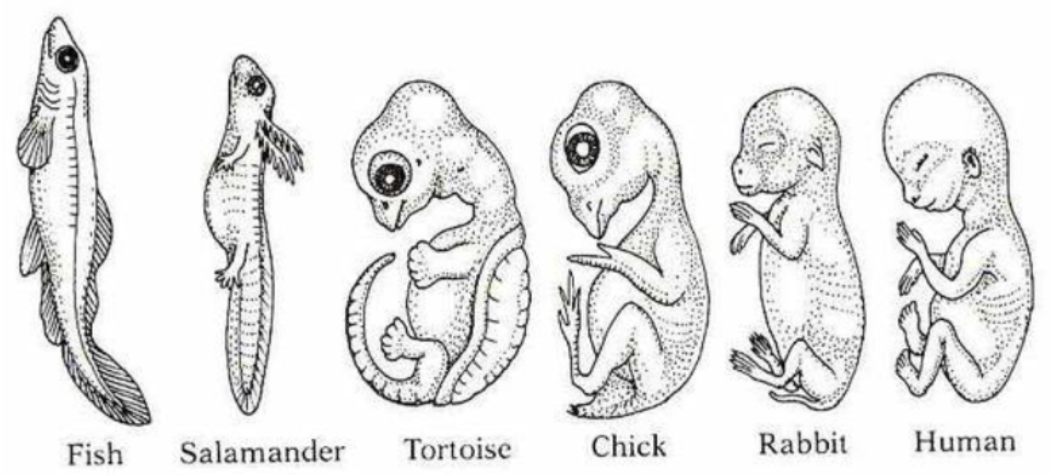
These are older, more developed embryos from the same organisms.




Hypothesize which embryo is from each of the following organisms:

| Species | Embryo |
|---|---|
| Human | |
| Chicken | |
| Rabbit | |
| Tortoise | |
| Salamander | |
| Fish | |

These are embryos at their most advanced stage, shortly before birth.




Describe how the embryos changed for each of these organisms from their earliest to latest stages.

| Species | Anatomical Changes From Early to Late Stages |
|---|---|
| Human | |
| Chicken | |
| Rabbit | |
| Tortoise | |
| Salamander | |
| Fish | |

1. Look again at the six embryos in their earliest stages. Describe the patterns you see. What physical similarities exist between each of the embryos?

2. Does this suggest an evolutionary relationship? Explain how.these embryos be used as evidence of a common ancestor between each of these six organisms?

3. Circle the development of a human embryo from the diagrams above

PROFICIENCY QUESTIONS

1. Fruit fly embryos and frog embryos differ from each other more than frog embryos and human embryos do. What does this tell us about how the three species are related?

2. The presence of gill slits and a tail in the early stages of development of an embryo indicates its future as a f

   - **A)** True
   - **B)** False

# **Station 4**: Fossils and Evolution

| Big Question: What do fossils tell us about evolution? |
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Directions

1) Pick a team leader

2) Look at horse fossils and answer 1-3

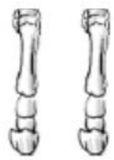
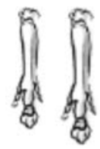
3) Call teacher

4) Take notes on the evolution of the whale.

5) Call teacher when everyone has mastered the content at this station and you are all ready to answer the big question.

## Fossils

This is a series of skulls and front leg fossils of organisms believed to be ancestors of the modern-day horse.

| | | | | |
|---|---|---|---|---|
|  |  |  |  |  |
|  |  |  |  |  |
| Equus<br>(modern horse) | Pilohippus | Merychippus | Mesohippus | Eohippus<br>(Dawn Horse) |

*Source: http://www.iq.poquoson.org*

1. Give two similarities between each of the skulls that might lead to the conclusion that these are all related species.

2. What is the biggest change in skull anatomy that occurred from the dawn horse to the modern horse?

3. What is the biggest change in leg anatomy that occurred from the dawn horse to the modern horse?

# Evolution of Whales Reading

During the 1990s our understanding of whale evolution made a quantum jump. In 1997, Gingerich and Uhen noted that whales (cetaceans) "... have a fossil record that provides remarkably complete evidence of one of life's great evolutionary adaptive radiations: transformation of a land mammal ancestor into a diversity of descendant sea creatures."

The trail of whale evolution begins in Paleocene time, about 60 mya, with a group of even-toed, hoofed, trotting, scavenging carnivorous mammals called mesonychians. The first whales (pakicetids) are known from lower Eocene rocks, which formed about 51 mya; the pakicetids are so similar to mesonychians that some were misidentified as belonging to that group. However, the teeth of pakicetids are more like those of whales from middle Eocene rocks, about 45 mya, than they are like the teeth of mesonychians. Pakicetids are found in nonmarine rocks and it is not clear how aquatic they were.

In 1994, *Ambulocetus natans*, whose name means "walking whale that swims," was described from middle Eocene rocks of Pakistan. This species provides fossil evidence of the origin of aquatic locomotion in whales. *Ambulocetus* preserves large forelimbs and hind limbs with large hands and feet, and the toes have hooves as in mesonychians. *Ambulocetus* is regarded as having webbing between the toes and it could walk on land as well as swim; thus, it lived both in and out of the water.

From late Eocene time onward, evolution in whales shows reduction of the hind-limbs, modification of the forelimbs and hands into flippers for steering, development of a massive tail, etc.; all of these changes are modifications for the powerful swimming of modern whales. The fossil *Rodhocetus* from the upper Eocene rocks, about 38 mya, of Pakistan already shows some of these modifications.